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Challenges for Rural Research and Development

by

Robert Chambers

The purpose of this paper is to state what seem to me, largely through the experience of this project, to be some of the challenges for research and development for rural South Asia. It is written against the frightening background of the world food and economic crisis, at a time when many of the people in South Asia cannot afford to buy or otherwise obtain the food they need, and when there is disappointment at the fading of the green revolution. But for all the setbacks and shortcomings there have been very considerable technical advances in agriculture and also advances in scientific organisation: a visitor to the higher-level research and plant-breeding stations - such as AICRIP and ICRISAT in Hyderabad, the Tamil Nadu Agricultural University at Coimbatore, or Maha Illuppallama and Batalagoda in Sri Lanka - cannot fail to be impressed by achievements of the past and excited by the possibilities for the future. Those who decry the Green revolution and the imagination and skill that have created what there is of it forget what it would have been like had nothing been done. The fact is that very large quantities of additional food have been produced in hungry and food-importing poorer countries. It is exceedingly easy for prejudiced and ignorant observers who have themselves never been hungry to wail from their well-fed sidelines that big farmers have gained more than small, that the main beneficiaries have been the multi-national corporations and their investors, that the effects have, in fact, been bad. The burden on us is not only to criticise but also to construct, not only to analyse what has gone wrong but also to learn from it how to help create something better.

In trying to do this, it is not difficult to suggest fields of research which have been relatively neglected by social scientists. These have dimensions both of subject - for example, case studies of landless families, and studies of intra-rural migration appear two needs and opportunities - and of geographical area, some more favoured areas being heavily surveyed and resurveyed, and others apparently neglected, as John Harriss points out (1974b). But the main thrust of this paper is not directed towards subjects which social scientists might more or less on their own open up, but on the linkages and complementarities between the work of social scientists and natural scientists.

We are, I believe, now less than ever in a position in which we can afford to allow social and natural scientists to proceed independently. In the past it has been possible for them to contribute to understanding and to rural development working largely in isolation. Seed-breeders, for example, faced with the potential of changing plant architecture to produce HYVs were probably (notwithstanding social scientist critics) quite right to get on with the job. A plethora of consultations, conferences and criticisms might have paralysed the programme. Similarly, social anthropologists have, I believe, been right in the past to do their thing in villages and to write up their monographs, because not enough has been understood about village life and we first need to explore and describe before we can prescribe. This stage is now passing. The easy things have now been done. Genetic yield potentials ceilings have been approached. Communicable diseases have very largely been controlled. Although far from satisfactory, the better work of social scientists has revealed and recorded, for those who will read it, much of the anatomy of rural life. But some of the next steps, for social scientists and natural scientists alike, may be much harder. There is, of course, always the option of "more of the same" and "in the same places"; and it is, indeed, because those options are so easy to accept and so likely to be accepted unless there is imaginative intervention, that I am writing this with an undertone of passion.

Since I am writing primarily as a social scientist, let me start by pointing out how seriously social scientists have failed their natural scientist colleagues, indeed the community of men as a whole. There is still no adequate theory of rural development. There is no analytical framework for categorising rural situations which can be used prescriptively; there is no theory of sequences and stages in rural development which can be used to identify what should be done in any particular situation.[1] Moreover, with the exception of courageous, confident and sometimes arrogant economists, social scientists have tended to be bold only in criticism and fatuous, feeble or misguided in advice. When asked for advice sociologists in particular tend to be either banal or wrong: banal in writing wordy reports which in effect say - "if the people like it, they will accept it, but if they dont, they wont"; and wrong in that they are not trained to make the sorts of judgements in which administrators and politicians are more expert and experienced, in that they are liable to make sweeping generalisations for policy which are not justified by the evidence (see Moynihan 1969 for an American example). Social scientists have to break out of the ruts of method in which they are stuck and to strike out in two directions: first, in search of practical theory; and second, in search of the types of experience which enable them to give more practical advice.

For their part, natural scientists - and I am referring mainly to those engaged on agricultural, irrigation and seed-breeding research - have been reluctant to admit that they have anything to learn from social scientists. In this, they have been more rational than many social scientists are prepared to allow, and their rationality has been based partly on lack of competence and lack of versatility in the social sciences. But we can recognise that this reluctance is liable to be a rationalisation for what is really a question of power.

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1. Guy Hunter has, however, sketched an outline of these stages (1970)

Research scientists see economists and others as possible threats to their decision-making autonomy; and they are quite correct in their perception. It is true that if there is an able and imaginative economist working with a team of seed-breeders, they will either fight or reject him, or their decisions will very likely be modified as a result of his contributions. The question is whether those decisions will be better than they would otherwise have been.

There is, in fact, a case for mutual education and mutual service between social and natural scientists. Each side has much to learn from the other. Again and again on this project we found that the problems and questions that we were thrown up against had a technical scientific aspect: farmers in Sri Lanka frequently rejected the basal application of fertiliser - who was right - them, or their advisors?; farmers in North Arcot would not grow IR8 in the samba season - who was right, them or the extension staff? In fact, it is interesting that it is at the farm level, where farmers themselves make no distinctions between natural and social sciences, that these questions arise. It is surely not a very far-fetched conclusion that understanding of and prescription for the farm-level cannot be a monopoly of any one discipline and that the major disciplines are complementary in contributing to insight and to improvement. Further, natural and social scientists have much that is of value to learn not only from their different concerns and techniques but also, perhaps more crucially, from their modes of thought.

Modes of Thought

Some of the breakthroughs and ways forward which are needed will, I think, derive from a more holistic view of rural situations, and from new combinations of ways of thinking and analysis.

This is far from being a prescription for an additive approach to rural research and development; it is emphatically not an injunction that every discipline should be represented on every project, or that every aspect of rural life should always be studied, or that a way forward can only be seen when everything has been examined and considered in detail. That would be rank nonsense. We are concerned with optimising, not maximising; we are concerned with costs and benefits, with returns to scarce research effort. Every discipline added to a research team is liable to add to the costs in communication within the team (Lipton 1970). What I am saying is that the span of concern of those who work on rural development should be broader rather than narrower, that there should be little respect for disciplinary boundaries, and that social and natural scientists should go to pains to learn from one another.

For social scientists the additional modes of thought and analysis which are perhaps most needed are systems thinking and ecological energetics. Systems thinking can help to ensure that all stages of processes are listed and considered. Ecological energetics can help to reveal human ecology as the management of energy, focussing attention on the efficiency of energy transfers. For natural scientists the additional modes of thought and analysis are perhaps

first, an economist's view of relative resource endowments, substitutions, trade-offs, and marginal productivities; and second a value system which includes a practical concern for human life and welfare and the equitable distribution of resources and services. There are no doubt many exceptions, but it is not unknown for natural scientists to dismiss as "people's problems" or "social constraints" whatever happens to the technology they have developed or the advice they have given once it is released to actual people. The purpose of all the scientific effort is to benefit people; and this has crucially to determine the form that the scientific effort takes and the criteria by which it is judged.

Applying these modes of thought to the survey areas in India and Sri Lanka, and setting the experience there against current research priorities and programmes, four challenges stand out. They are by no means the only ones; and I am not asserting that they necessarily have or should have priority over others, since "priority" relates to decisions about resource allocations which are complicated and which an outside observer cannot pretend to know enough about. But these four are, I believe, important and likely to have high returns in terms of human welfare in the areas concerned and perhaps very much more widely in South Asia and elsewhere. They concern research and development for future human eco-systems; seed-breeding; water management, and the social and psychological technology of researoh.

Research and Development for Future Human Ecosystems

It may seem inappropriate for a person from a country which is profligate in its energy wastage to observe the need in South Asia to develop rural ecosystems which are both stable and adaptable to change. In the world perspective, the SALT negotiations, on which future energy consumption and technological investment in the West and Russia so largely depend, have an overarching importance, greater in the longer-term than the population-food problems of the next few years. It is also quite correct, as Mrs. Gandhi has pointed out (The Times, 7 December 1974), that the West bears heavy responsibility for the present world crisis. Nevertheless these are all now global problems. Many of the solutions must be sought and found in more sparing use of resources in the developed countries. But this should not be allowed to divert attention away from the problems and the opportunities for designing and creating ecosystems in rural South Asia which might sustain at a tolerable standard of living, the much larger populations which can be expected.

A case can be made for two complementary approaches. The first is subject-specific; the second is environment-specific.

Subject-specific issues for R and D can be thrown up from analyses of systems and efficiencies in resource use and in particular energy transfers. Such analyses throw up gaps in knowledge and research. By following water, energy and other resources right through the processes of combination and use it is possible to see that there are neglected wastages and that certain transfers might repay much more careful attention. By way of illustration, some examples which arise from this approach in the context of rural South Asia are:

- the identification of water as often a scarcer resource than land, leading to examination of water use efficiencies (see water management section below)

- pre-harvest losses of grains to rodents (Roy,(1974) found losses on a research station of 7.1 per cent and he regarded this as an underestimate)

- the efficiency of the human gut in absorbing carbohydrates. Very little research has been done on this subject[2] and efficiencies are believed to be of the order of 90 per cent. But how this varies, and under what circumstances, and what scope there may be for improvement through adjustments in diet or other measures, is apparently not known. Yet in India, for example, an improvement of only one per cent would be worth over a million tons of foodgrains.

- losses of food to intestinal parasites

- digestible calorie yields of grains instead of yields by weight. The proportions of digestible calories vary considerably, yet crude yields by weight are still used by agricultural scientists.

If it is correct that these have been neglected, the reason is not far to seek. For all these efficiencies or coefficients are difficult or troublesome to measure. Returns to water are much harder to record than returns to land; pre-harvest losses of grain, as Roy points out, are exceedingly difficult to estimate with any accuracy; measuring the efficiency of the human gut in digesting carbohydrates requires metabolic wards, total systems of control of experimental subjects, and intensive supervision and measurement of a particularly exacting kind; it is by no means easy to estimate the calorie losses to intestinal parasites; and although the conversions are not difficult to make, it is easier to think in terms of grain yields by weight than by calories. All groups of researchers tend to do what can easily, safely and respectably be done and written up in nice little papers for journals. We need a change of values within research communities to research much more the daring, risky and uncertain exploration and opening up of areas which have hitherto been neglected because of their difficulty and we must be much more ready to accept orders of magnitude in research reports.

An example of subject-specific R and D where many initiatives are contemplated or in hand is plant nutrients. In 1969 in contrast with the USA, Australia, the UK and even Ethiopia, India had a negative nitrogen balance (Nutman 1974, table 9). While I am not competent to judge the seriousness of this, it is heartening that so many ideas are being considered or tried out. It may be of interest to list some which have been mentioned in the course of visits to research and breeding stations and in discussions elsewhere:[3]

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2. Based on scanning nutrition journals and abstracts in the library at the Indian Institute of Nutrition, Hyderabad, and an interview with P.S.V. Ramana Murthy whose rather incondusive work in the mid-1960s has apparently not been followed up (Ramana Murthy and Belawady 1966).

3. Some of these items are from B. Harris 1974 and Rajagopalan 1974. I am also indebted to S.V.S. Shastry, Rupert Sheldrake and discussions at the IDS Conference on the Food Problem in South Asia 1975-1990, November 1974.

- green manure (albecia leaves, etc.)
- cowdung
- citronella ash
- burnt paddy husk
- nightsoil and urban compost
- tank mud
- other composts
- seeding paddy fields with blue-green algae
- seeding irrigation tanks with blue-green algae and then harvesting them
- the development of N-fixing pastures and seeding these in tank beds (no research on this is known in the geographical area between Japan at one end and Israel at the other - personal communication W. Klatt).
- labour-intensive fertiliser placement in the soil
- carefully times and split N applications to decrease N losses and to provide N at the highest response times in the life of the plant
- research on the relationship between nutrient uptake and season
- the introduction of legumes into cropping patterns
- closer spacing to reducing weed growth and loss of N, P and K, to weeds
- closer spacing to increase N fixation in the phizosphere of paddy plants
- improved N-fixing micro-organisms for the paddy phizosphere
- combining biological N-fixation (blue-green algae and root micro-organisms) with chemical N by applying the chemical N (which inhibits biological fixation) late in the life of the plant
- breeding with an eye on the N response curve, preferring varieties in which the initial rise in calorie yield is high
- slow release N fertiliser

No doubt many other examples could be added. The point is that here is a priority research area which is being vigorously and imaginatively explored. It can scarecely be doubted that the range of research being promoted is likely to produce many useful substitutes and complements to chemical fertilisers.

The second approach is to examine particular types of human environment and ecosystem. This is being undertaken in the Indian Drought-Prone Areas Programme and also in the Command Areas Development Programme for major irrigation systems. It can similarly be applied to other environments such as semi-desert pasture lands, and mountain zones. I want to suggest, however, that in addition to what is already being done, this approach should be decisively future-oriented, with estimates of future resource endowments, particularly population, and with attempts to design appropriate technologies for possible futures. A non-numerate attempt has been made to do this for part of North Arcot District in another paper (Chambers 1974). The point is that thinking in this way, backwards from the future, provokes, indeed demands, a specification of what that future should and might be like, and this leads in turn to specification of the technologies which are required to make it

possible. In that case, as perhaps generally, key specifications may be that there shall be a continuous labour demand throughout the year and that all technologies should have sharp economies of very small scale (as perhaps with solar pumps). It may well then turn out that the choice of technology to develop and to make available has almost revolutionary implications for the future distribution of resources, in the case of North Arcot perhaps creating a rural system lending itself to redistributive land reform. It seems well worth exploring what scope there may be for achieving or making easier through choice of technology the equitable distribution of resources which has proved so difficult for lack of effective political will.[4]

The implication of all this for research policy is that types of rural environment should be identified and subjected to creative future-oriented R and D examination on a systematic basis. Some initiatives somewhat like this are, no doubt, under way. But it may well be that they need some critical extra inputs and types of interaction between disciplines if they are to make the leaps of imagination which are necessary and if they are to have the impact on the development of technology which is required. At present one has to ask whether many natural or social scientists are ready and willing for the types of intellectual and psychological interaction which are necessary.

This is partly because this approach would affect the work of all of them and would very likely shift their priorities. For example, labour demand profiles in farming systems might be a prime focus. To design future farming systems with this in mind would give a new twist to the work of agricultural economists, and might revolutionise the work of a seed-breeder or agricultural research scientist. The classic example here is from West Africa where after long and bitter argument the agricultural scientists were finally persuaded to conduct research based on suboptimal times of planting for cotton because there was no prospect that sensible farmers, who gave priority to food crops as soon as the rains came, would ever plant cotton at the optimal time. Similarly, elsewhere, research could and should be carried out with a view to fitting into farmers' behaviour which is rational by farmers' own criteria.

Finally, it should be noted that this approach involves a different sort of thinking to the normal project and programme approach. For sound practical reasons it has been usual ("planning" notwithstanding) to seek to promote development through a series of projects and programmes. Nothing here should be taken as an attack on that approach. Without having to have a paraphernalia of perspective plans and statistical projections, it is possible to be confident beyond any reasonable doubt that certain initiatives are going to be beneficial: the building of roads, the installation of surface irrigation potential, providing access to family planning for those who want it, and so on. The difference of the supplementary approach advocated here is that it tries to work backwards from a possible future to see what has to be done now so that that future can be realised; and in particular what R and D has to be undertaken.

Seed-breeding

Seed-breeders have suffered from over-dramatisation (there is now even a novel, by Angus Wilson, about them) and have been subjected to occasional unjustified attacks. They should, however, be complimented at this attention. It follows from the importance of their work and the priority (and jeajousy perhaps) with which others regard it. They should also understand that it is precisely because their decisions (often hidden away and protected from sight in technical or quasi-technical corners or preliminaries) are so important that they justify opening up to much more

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4. There have, of course, been eruptions such as the land reforms of Kerala and Sri Lanka.

public view and much more careful appraisal. To paraphrase Clemenceau, seed-breeding is too important to be left to the seed-breeders.

One of the most crucial aspects which deserves to be examined is the relative trade-offs between alternative target characteristics. Some are easier and quicker to obtain; others more difficult and take longer. Some may be mutually compatible; others mutually incompatible. An estimate of costs (breeders' time, benefits foregone through longer lead-times, opportunity costs of various sorts) and of benefits (increased production, distribution of benefits within the society, adaptability of the seed to a range of conditions, etc.) ought to be made before and during the process of developing a new seed or family of seeds. This is eminently a task for a good agricultural economist who should be able to serve breeders both through calculations of trade-offs and through estimates of benefits through diffusion. Further, the specification of characteristics is an activity which should now follow from careful examination of the requirements of the receiving environment.

Breeders may claim they are competent to carry out these activities themselves. Certainly the tendency for breeders to spend time out in farmers' fields listening to farmers is likely within reason to be time well spent; but with their other skills and the exceedingly high returns in terms of benefits and production to the expenditure of their time on their highly skilled breeding activities, it would be wasteful for them to devote substantial periods to work for which agricultural economists are more professionally qualified.

Questions of target priorities are, moreover, complicated and difficult. There are a very large number of alternative or complementary characteristics towards which breeding may be directed. To genetic yield potential and N-response can be added non-lodging dormancy, drought tolerance, parboiling and milling quality, palatability, grain colour, grain shape, resistance to various pests and diseases, the content of various amino-acids, photoperiodic insensitivity, duration, adaptability to particular environmental circumstances (salinity, high flooding, high, medium or low altitude, etc.) and now N-fixing capability in the rhizosphere. A further complication is the manner in which perceived priorities change. In Coimbatore grain colour was abandoned about ten years ago since breeding for it was holding up the release of new strains. Protein content has come in as a priority and then gradually fallen from favour. Pest and disease resistance is a priority with which no one would wish to argue, with its potential for reducing risk for farmers and also saving foreign exchange otherwise required for pesticides.

It is true that the injection of agricultural economists into the decision process may make it a little more lengthy; but it is not that that matters, but whether the anticipated improvement in the decisions which emerge is worth the costs. There are four most obvious benefits:

(i) the choice of crops to which to devote seed-breeding expertise

(ii) the improved specification of characteristics desired

(iii) the anticipated yield effects from the receiving environment

(iv) the distribution, income and nutrition effects.

In order to illustrate the general point, I shall take only the last item. The disillusion with political and administrative measures for reaching the poorer rural people is deep. But technology is not neutral. It too has considerable distribution effects. And the choices made about seed-breeding priorities are surprisingly wide-ranging in their effects. If reaching and helping the smaller, poorer farmers and the poorer rural people is an objective, then the following apply:

- preference for stable to unstable seed. Smaller poorer farmers have difficulty obtaining inputs such as seeds. If they once obtain a stable seed, then they can replant from their own resources year by year without loss of yield.

- higher-yielding varieties of the sorts of food crop grown and eaten by the poorer sections of the community can be expected to benefit them disproportionately; this applies also to the crops grown in the less well endowed areas (millets come to mind)

- preference for varieties with high yields of calories under conditions of low fertility, and which have high slopes in the early stages of their N response curves, will favour the smaller poorer farmers who have more difficulty in obtaining fertiliser.

- water stress tolerance will benefit those less well-endowed farmers whose fields are more likely to be short of water. A stress tolerant variety may make the difference between a crop or no crop, or between two crops and one crop. for a farmer who lacks a really reliable water supply

- short duration varieties may disproportionately benefit those farmers who are unable to plant in a timely fashion, whether for difficulty in obtaining inputs (labour, tractors or buffaloes or oxen, seeds, fertiliser, or water at the tailend of major irrigation systems). They may (as BG34-6 and BG34-8 have done in Sri Lanka) have a beneficial effect for those who otherwise would suffer.

- photoperiodic insensitivity has a similar effect

- varieties which have a high return to labour-intensity may tend to favour the very small farmers who can rely on the family labour with a negligible opportunity cost

- breeding varieties which will fit into existing farming systems and existing or anticipated farm labour demand profiles will tend to benefit the poorer smaller men who are unable or less able than their better-off neighbours to attract or pay casual labour

- breeding varieties which can be interplanted with other crops to reduce risk and increase calorie yields (can perhaps N fixation) may benefit those with very small plots of land

- varieties which are independent of mechanical requirements will reduce dependence on those who monopolise tractors or other machines. H4 in Dri Lanka, for all its other excellece. was difficult to husk without a tractor, and this requirement increased the dependence of smaller farmers on their richer patrons.

An example of the benefits from a multi-disciplinary approach is provided by a recent study from ICRISAT (Ryan, Sheldrake and Yadav 1974). Sorghum breeding has been dominated by the United States and has been prominently pursued in Purdue University which serves the needs of livestock producers in the mid-West. The main criteria of successful breeding are therefore protein content and yield. As has been amply demonstrated by, among others be it noted an economist (Joy c. 1972), it is futile and wasteful to supplement calorie-deficient diets with protein since the protein is used by the human body not as protein but as energy. Moreover, most Indian diets are not protein-deficient; it is calorie-deficiency that is widespread. The priority for people in India therefore, in sharp contrast with steers of the mid-West, is for sorghums with high usable carbohydrate content. To quote Ryan, Sheldrake and Yadav:

> "The major component of both the cereal and pulse grains is carbohydrate. But by no means all of this carbohydrate provides dietary calories. A small proportion of it is made up of soluble sugars, some of it starch, which is digestible, and the remainder consists of cellulose and other cell wall materials which are not digestible.

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> In Sorghum the amount of starch in the grains varies considerably from variety to variety. It may be as low as 42 per cent or as high as 68 per cent. The starch content of the grains varies independently of the protein content.. The large varietal differences in starch content mean that varieties which may have the same protein content and grain yield per hectare may differ by more than 50 per cent in their calorific food value. Such differences cannot be known nor selected for unless the grains are analysed for starch."
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> (1974: 26-27)

It is, in fact, largely irrelevant and potentially misleading in the Indian content to be concerned with protein content. Effective protein absorption by the body is more likely to be achieved by concentrating on improving the starch content, not the protein content, of sorghums. In the absence of critical appraisal, by economists and others, this might not have been identified. Sorgham-breeding for the semi-arid tropics might have produced sorghums with lower calorie yields which would have been worse for the people who ate them.

A further important aspect of seed-breeding in which seed-breeders must surely welcome further insight and advice is the reasons for low or high levels of adoption. Some of these have been analysed elsewhere (Chinnappa 1974; Dias and Gunawardena 1974; Harriss, J.C. 1974). In terms of total food production resulting from innovation it is alarming, and must surely repay further investigation, that overadoption should be identified in Sri Lanka (Dias and Gunawardena 1974). But in India, the survey findings that adoptions of new HYVs are apparently much lower (about one third) than those appearing in official statistics (Channappa 1974) suggest a need to go back to the HYV drawing board and look much more closely at the specifications for successful varieties. As observers seem to agree, more environment-specific (and perhaps season-specific) varieties need to be developed. An HYV for the seru (oozy) soils in North Arcot for the samba season is, for example, needed. But in order to arrive at sound priorities, a continuous appraisal of need, of the scale of possible adoption and the degree of benefits accruing, is required. This is something which no seed-breeder can or should be expected to have to do for himself.

In the new situation following the energy crisis the shifts in priority have been sensible. There has been much heart-searching. Among other questions it seems right to ask about the physical conditions in which breeding takes place. The gibes about specially favoured conditions on research stations, with their reliable water, their fertile soil, their access to inputs,[5] and their unlimited supplies of (unmeasured, uncosted) labour ought to have passed into history, but they appear almost as justified now as ever. In the context of seed-breeding, there may be a lesson from the experience of Hector Weereratne at Batalagoda in Sri Lanka. He rather modestly attributes the wide adaptability of H4 (which he developed) partly to the unfavourable drainage conditions on the Batalagoda plant-breeding station. Any variety which did well in those conditions had to be robust. One wonders whether a similarly automatic (but adverse) form of selection may not have taken place over the past ten or fifteen years through the heavy doses of N given (reportedly 80 - 160 kg/ha) to paddy plants while being grown for selection through the crucial F2 - F4 generations. Is it possible that varieties which would have been more adaptable have not been selected? That we have been left with varieties which do well under ideal conditions, but which were not designed for the rough-and-tumble of the poor man's fields? Could it be that more varieties like H4 could have led to higher field calorie yields than some of the more spectacular varieties that have been produced, and the adoption of which has been rather limited? For the benefits from a lower-yielding variety which is widely grown may be much greater (in terms of distribution of benefits among farmers, in terms of gross food production, in terms of lowered food grain prices) than those of

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5. When I asked one scientist whether the energy crisis had affected research priorities, he looked puzzled, and then replied that, no, the research station could still get all the fertiliser it wanted. (interview 1974).

a higher-yielding variety which is only adopted by a few (and we know who they are) who can afford and obtain expensive inputs.

Finally, one may ask whether the status and reward systems of seed-breeders provide the right incentives. "Super-gene competitions" (as I have heard biannual conferences of breeders described) may not be the best means of encouraging pursuit of the best objectives. The field adoption of a lower-yielding variety on a wider scale should be a bigger feather in the cap of a breeder than the achievement of a yet higher genetic yield potential in a variety which does not become widespread. This is perhaps largely the case; and if so, should be reinforced.

Water Management

Water has been a strangely neglected component of the agricultural system. To be sure, there have been huge investments in irrigation, in tubewells, in pumpsets. But there have been really bizarre gaps in perception and in research. One example must suffice. The Mahaweli Ganga Irrigation and Hydropower Project in Sri Lanka is the single largest project in the country, and has as part of its object to irrigate new land and to provide supplementary irrigation. The UNDP/FAO multi-disciplinary multi-member mission of experts in its final report stated that out of 1.5 million acres potentially under command only 0.9 million acres could be irrigated because of the limited water available (UNDP/FAO 1969a: 55-6). It might have been supposed that in these circumstances in which it was water rather than land that was constraining, careful attention would have been paid to the arrangements for managing the distribution of the water. But the volume of the final report which deals with "Organizational and Management Requirements" apparently considers improved seed, fertilizer, other agro-chemicals, tractors and equipment as inputs but not water. 8 pages are devoted to the supply of these inputs, 7½ to marketing, a further 7½ to agricultural credit and cooperatives and 8½ to agricultural research, extension and education. Apart from tangential references, the main presentation on managing water distribution is less than one page dealing with administration at the lower levels, mentioning structural but not operating arrangements (UNDP/FAO 1969b: 72-3). And this neglect was the more reprehensible given the well-known difficulties in water management which have beset other large-scale projects in Sri Lanka and which have been constraining on the acreages cultivated.

An explanation of what appears culpable negligence seems to be that the management of people who manage water is not a subject that has discipline. The water management specialist on the UNDP/FAO team was an irrigation engineer concerned with quantities and flows and structures. The agricultural economist very sensibly did analyses in terms of returns to water with different cropping patterns. The sociologist carried out surveys and noted that the distribution of irrigation water appeared to be a concern of both staff and settlers elsewhere, but did not take it any further. Blinkered, it seems, by their narrow disciplinary views, all the experts (and there were many others as well) missedd the most important point of all.

There are compelling reasons, not just part neglect, why water and water management should be moved much more into the centre of the stage in South Asia. First, a very recent opinion is that "The greatest potential source of large increases in the present levels of food supply will come, in the next decade, from increasing efficiency in existing irrigation systems and exploitation of known groundwater resources" (Carruthers 1974:1). This point can be substantiated from the low rates of utilisation of many existing surface gravity irrigation systems, the improvement of which in India is actively in hand with the Command Areas Development Programme. Second, water is peculiarly critical. Nitrogenous fertiliser has been something of a prima donna during the past ten years or so, and the very obvious point has tended to be obscured that if there is water crops can usually be grown whether there is chemical fertiliser or not; but if there is no water chemical fertiliser is useless. Water is the more critical input. Third, water is land-augmenting. More water more

sparingly used can increase the cropped acreage, the cropping index and the food produced. Fourth, water has strong implications for adoption of HYVs. The evidence of the survey confirms that adoption of HYVs in paddy is strongly associated with reliable water supplies in North Arcot (Chinnappa 1974). Fifth, reliable water supplies have equity implications; in particular, one of the less expected findings of the North Arcot survey was that it was precisely in those villages which had the more reliable water supplies (Vegamangalam, Dusi, Vinayagapuram, and Randam) that very small cultivators had adopted HYVs.[6] Sixth, it is a reliable year-round water supply more than any other factor which appears to be responsible for the higher wages and greater employment demand of North Arcot villages like Kalpattu. If as is argued elsewhere (Chambers and Harriss 1974) a quasi-industrial rural economy is a desirable target in order to provide more continuous employment, the careful husbanding of water and its utilisation throughout the year are critical.

The implications for research are considerable (see also Bandara 1974). The first priority is that holistic systems thinking should be applied, rural environment by rural-environment, to water-relating surface water to groundwater, considering alternative storage and delivery systems, and considering above all the human and organisational aspects of water allocation and appropriation. Research on the management of water management needs urgently to be initiated and pressed ahead. The returns to such research in terms of additional food produced might be very high indeed, comparable with the very high returns from seed-breeding; there would also be major equity and distribution aspects. A second priority is that all the implications of treating water as more critically scarce than land should be followed through. To be sure there are very substantial areas - most of the wet zone of Sri Lanka, the Cauvery delta in Thanjavur, the Godavari delta, much of Bangladesh - where for part of the year at least water is not only not scarce but sometimes too abundant. But these areas have perhaps tended to dominate thinking to the neglect of areas like the Dry Zone in Sri Lanka and like North Arcot District, where water is much more constraining. In research for areas such as these latter, benefits should be measured as returns to water. It would be excellent if instead of tables of yields of grain per hectare, all research stations could make it a rule that tables should be presented also in terms of digestible calories harvested per litre of water applied.

Water management is perhaps par excellence a field in which natural scientists and social scientists must talk to one another and must individually move out from the narrow boundaries of their disciplines. It is a vital field, and it is exciting. It calls for new research of a new sort, with a high degree of innovation. Let us hope that it will attract the initiatives which it deserves.

The Social and Psychological Technolcgy of Research

Enough should have been said to establish the need of natural and social scientists to communicate with one another and to help one another. The argument has tended to be weighted, perhaps in partisan fashion, towards the need of the natural scientists. But in fact social scientists are at least as badly in need of being drawn out of their routines and cramped perceptions into the larger world of a holistic and ecological view of the environments which they study. It can be very exciting and mind-stretching to learn the ways of work and thought of other disciplines. It can and should also, as I have asserted throughout this paper, improve the quality and usefulness of the research done - whether in future-oriented R and D for rural environments, or in seed-breeding, or in the management of water. The question is, how to bring it about.

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6. Kalpattu is not included because almost all cultivators in Kalpattu grow only CO-29 and only for domestic consumption. They do not appear to regard paddy as a research or a commercial crop, preferring to grow bananas and turmeric for the market.

by Robert Chambers

It is here that we appear peculiarly barren and ritual-bound. We seem to be unable or unwilling to invest time and imagination outside the status systems of our own disciplines. Why has no social scientist written a text on social sciences and the rural environment with seed-breeders and agricultural scientists as the intended audience? Why has no seed-breeder to the best of my knowledge written a text for social scientists explaining the methods of his art or science, the nature of the choices he makes, and the constraints and opportunities with which he is faced? Why is it, with sublime irony, that it is only on a farmer's fields that the multifarious disciplines all meet in a world which the farmer, in his genuinely superior wisdom, does not divide up into mutually exclusive categories?

We need, perhaps, to be much more creative and daring in the social and psychological techniques which we use in order to communicate, to think, and to innovate. Total immersion think tanks, various methods of prediction, communication networks involving several disciplines but with the same non- or inter-disciplinary focus, perhaps techniques rather like group therapy - these are among approaches which might be tried. Somehow we have to get away from being too careful in our ideas. Nothing inhibits creativity like fear of ridicule. But new truth often appears absurd and one of the most important qualities to be nurtured is a willingness to take the risk of looking an ass. We worship intelligence, but intelligence far too often is identified as the quality of avoiding being demonstrably wrong about anything. The generation of wide ranges of original ideas about the problems and opportunities of South Asia (as indeed of other parts of the world) is something which can be deliberately nurtured by bring about particular social and psychological situations. The vast majority of new ideas may be rejected. But those which survive the necessary tests of stringest criticism may between them transform a situation of ominous foreboding of doom into one of buoyant hope for better lives for rural people. Let it not be for lack of daring what we, the collective human we, fail. The challenge is as open and as crucial as anyone could wish.

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